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ABSTRACT

This paper describes a tutorial lesson to give teachers a model against which to compare and contrast a variety of instances of such lessons, and to help them to eventually come to a personal position on what constitutes a tutorial computer lesson. Three flow charts are provided as examples of tutorial style episodes. This resource for preservice and inservice teacher training includes a suggested study activity. (Author/CMV)

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Number 6e

The Illinois Series on Educational Application of Computers

TUTORIAL INSTRUCTION ON A COMPUTER

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To the reader,

This is one of a series of documents prepared as resources for the preservice and inservice training of teachers. The general theme of all items in this series is "teaching with or about computers". The booklets are the collective work of a variety of staff and students (both present and former) of the College of Education, University of Illinois at Urbana-Champaign. The project generously was supported between 1977 and 1979 by a grant from the EXXON Education Foundation. All responsibility for the content of these documents rests with the authors and does not reflect necessarily the views of the EXXON Foundation. It was my extreme pleasure to direct this effort throughout.

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TUTORIAL INSTRUCTION ON A COMPUTER

The literature of instructional use of computers has numerous reports describing materials referred to as tutorial programs. Examination of several computer lessons labeled "tutorial" will reveal a range of features and designs. Some authors (by their examples) view the tutorial style as sequences of question episodes interspersed by text episodes, so that the computer addresses the student by alternately giving information and questioning about it. Other samples of "tutorial" lessons appear more elaborate in aspects such as the ability to vary the difficulty of questioning, a provision for defining terms or explaining phrases when needed, or a variety of other features directed at accommodating individual differences. In this paper we shall attempt to present the teacher with a description (admittedly idealized) of a tutorial lesson. We do this not to establish our description as the "only truth" but rather to give the teacher a model against which to compare and contrast a variety of instances of such lessons and eventually to come to a personal position on what does or does not constitute a tutorial computer lesson.

We define a tutorial computer lesson as a simulation of the interaction between the "ultimate" instance of an expert teacher and an arbitrary learner. In this sense, a tutorial lesson may be viewed as a concept from the field of artificial intelligence--an attempt to create, in machines, a type of exemplary human behavior. The basic elements of a tutorial lesson consist of an array of question episodes together with an intricate network of decisions connecting these episodes. The attempt is to simulate a very personal, and individually tailored, conversation between the "expert" teacher and a widely varying student.

Earlier we defined a question episode (see ISEAC No 4e) as composed of several elements, including 1) replies and reinforcement for correct answers, 2) helpful suggestions to conceptually correct but literally incorrect answers, 3) correcting replies to predictable incorrect answers, and 4) suggestions on how to procede or to seek help with an unexpected or unidentifiable incorrect answer. In a tutorial lesson, these features must be greatly expanded in the sense that the functioning of the computer program is dominated by the methods of treating the unexpected responses. There are several conditions in which a student might give an unexpected response to a question. The question might be too difficult for the student at the current point in time. The question might not be understood because of the presence of unfamiliar words. The phrasing of the question might not be interpretable, in which case an alternate phrasing of the same question is in order, or the student may be

becoming bored or tired. A good teacher senses when such events occur and can take immediate and appropriate action. A tutorial computer lesson designer attempts to replicate this behavior without the immediate presence of the learner who eventually will provide many important cues to the process.

Now, the reader may sense an incongruence between the definition of tutorial style lessons and the emphasis placed upon dealing in such lessons with the unexpected events. Would one not expect that an important attribute of a very good teacher would be that unexpected events in the teaching/learning process at least are reduced in number if not minimized? The answer, of course, is a very qualified affirmative. Good teachers do appear to have fewer unexpected events in their efforts to facilitate learning but by no means do such events ever totally disappear. At this point in time, educators know far too little about the details of the learning act to permit highly reliable predictions of learner behaviors in a variety of settings and subjects. What probably happens as a teacher becomes experienced and consequently more effective is that abilities to cope with unexpected events get extended to the less frequently occuring and more subtle of these events. In computerized tutorial lessons, one attempts to simulate this experience through an increase in provisions for less predictable events and through more sophisticated procedures for attempting to diagnose the sources of previously unexpected events.

Tutorial lessons are more than networks of elaborate question episodes. The network of question episodes is put together with a strategy in mind. Early in a tutorial lesson the strategy may be to cause the student to acquire a particular conception of a topic, perhaps without actually articulating all the elements of that conception. Rather, the student becomes aware of the various elements through the contents and the ordering of the question episodes and the responding provisions included therein. This may take the form of a carefully designed mix of examples and counterexamples. The examples, through their common elements, form a basis for a general concept, while the counter-examples serve to bound and to quantify the general conception. The computer becomes aware of the emergence of the particular conception in the learner through the answers given to carefully selected and designed criterion-type questions or exercises.

As a teacher-led tutorial lesson procedes, a point is reached at which the student appears to have grasped the conception desired. At this point in time, the style of questioning may take a decided turn. Until this time, questioning largely is directed at the creation and shaping of the conceptual world of the lesson. This type of learning centers around the question "What are the dimensions of the subject?" Following indications of some student understanding, questioning frequently takes on the flavor of

prodding the student to formulate a defense as to why the dimensions of the subject are as they are.

These features, too, must be built into a tutorial-style computer lesson. The computer must be prepared to identify when the transition from "awareness building" to "defending" style questioning should begin. The computer also must be equipped with some looping or recovery strategy in the event that this transition decision proves to have been made inappropriately.

All of these provisions must be included in the planning of tutorial lessons or must be incorporated as a result of trials of early approximations of such a lesson with sample students. Decisions likely to be required in teaching can never be predicted totally before the fact. This seemingly endless need for improvement is an attribute of the tutorial style that probably accounts for much of the difficulty with that style. To see this from a more specific point of view, we offer flow diagrams of what might appear in practice as a rather elaborate example of a tutorial style episode (see Figures 1,2 and 3).

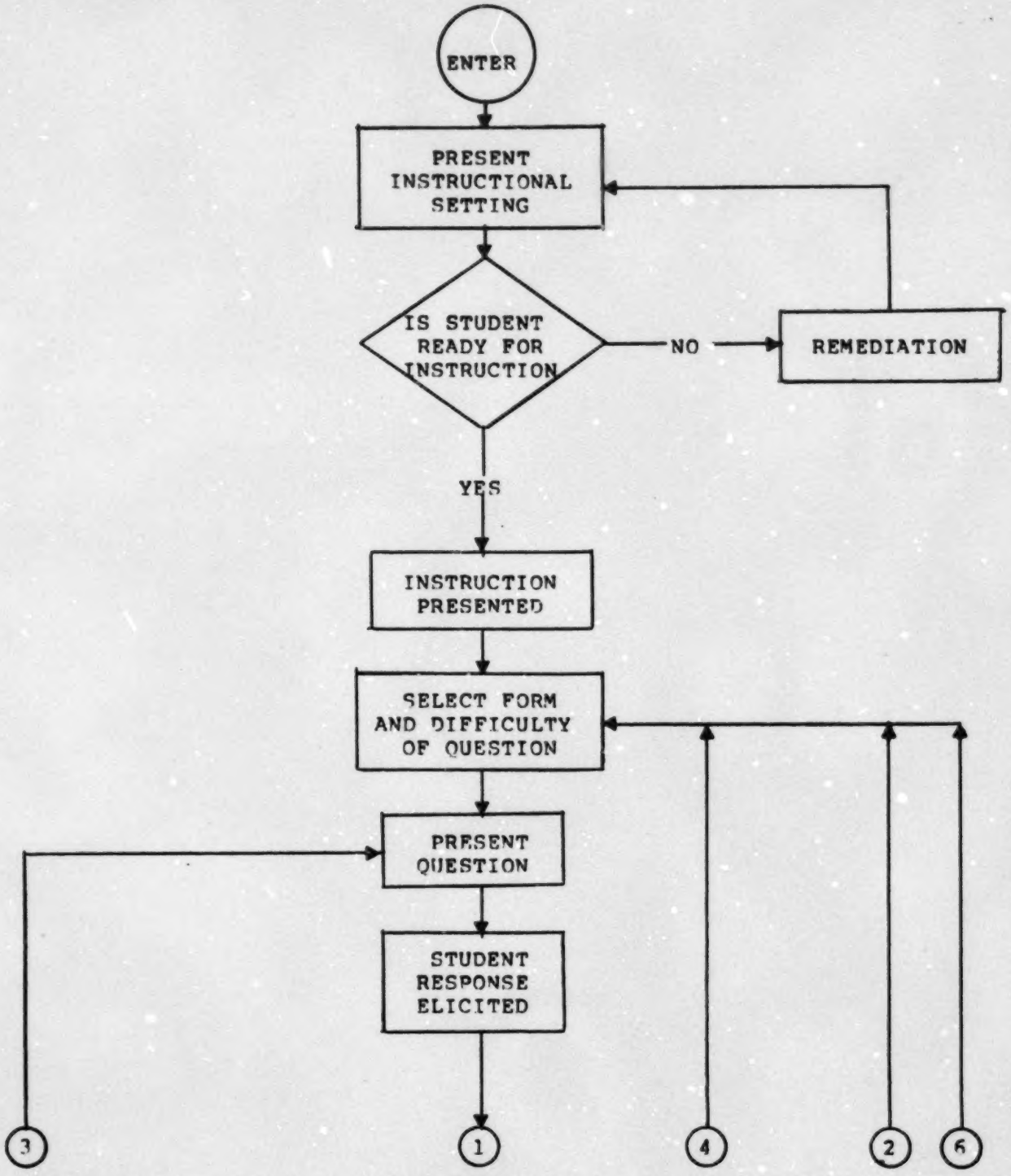

FIGURE 1
Evaluation of Readiness and Presentation of Instruction

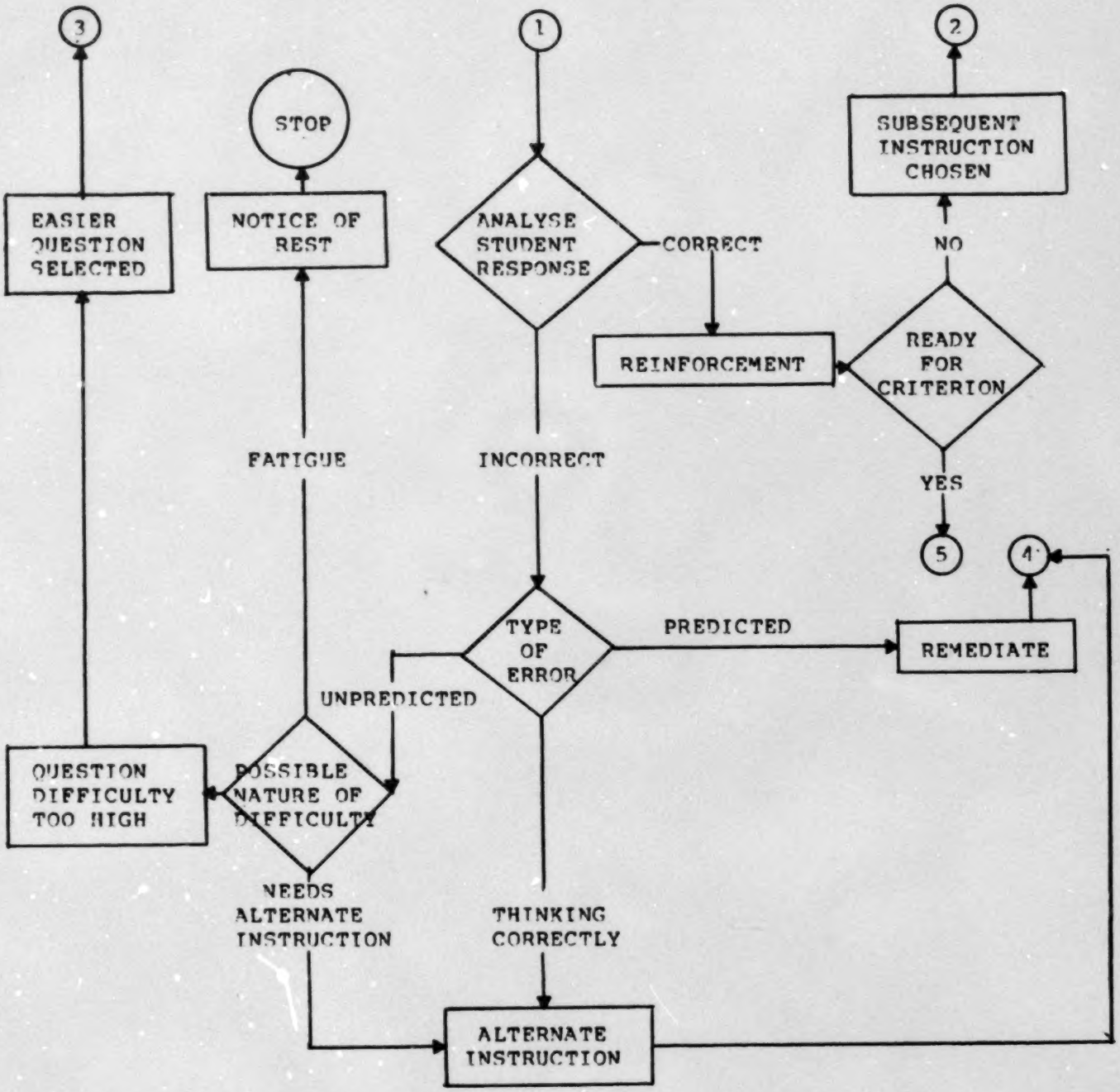

FIGURE 2
Evaluation of Response and Appropriate Action

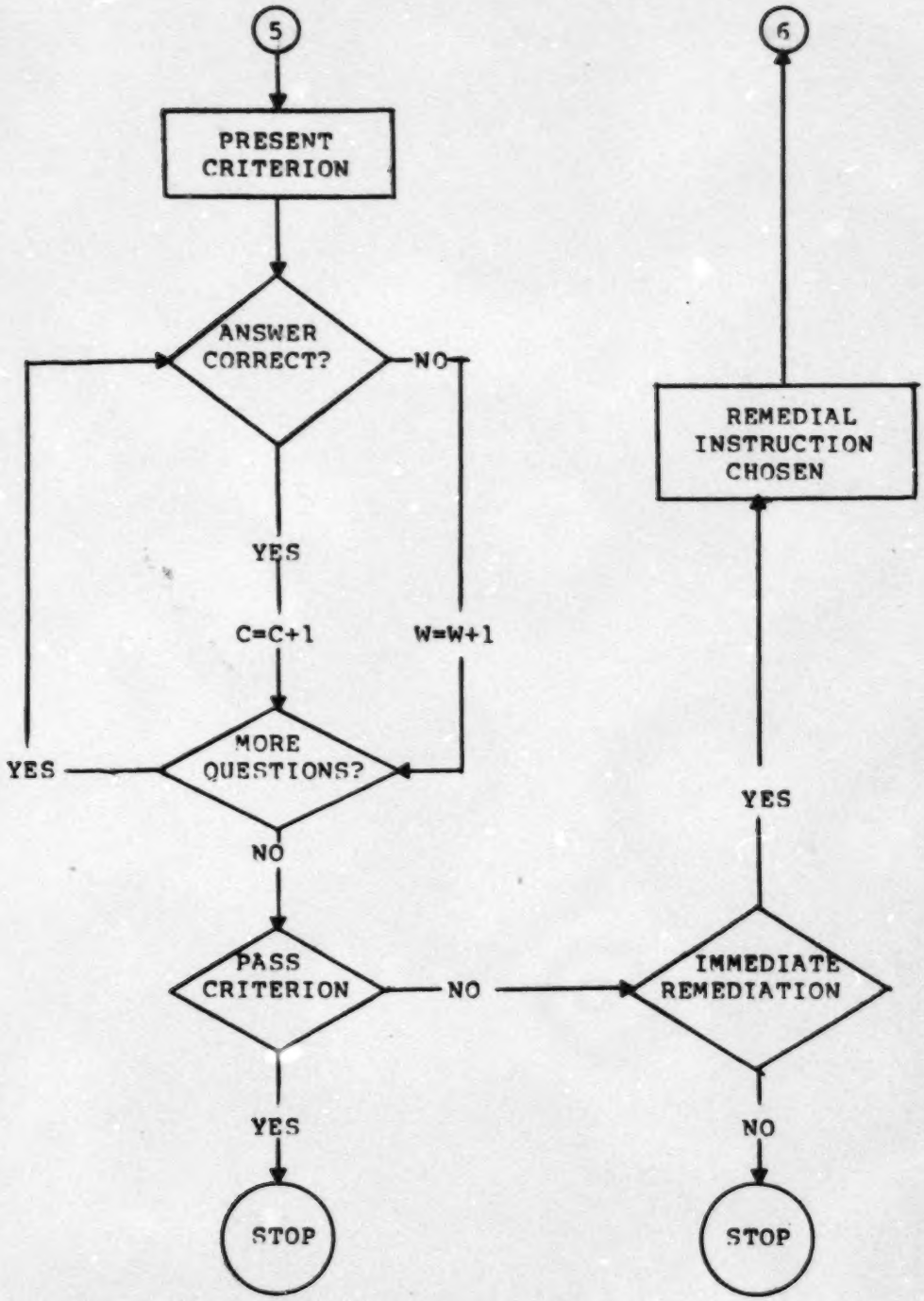

FIGURE 3
Criterion Presentation and Evaluation

Notice the seeming complexity of this environment. Provisions have been made for a wide variety of incorrect and unpredicted responses. Additional references or helps are available throughout. The difficulty of questioning is varied when a student has trouble with one level of question. Under careful analysis, however, the reader will find several weakness in this tutorial plan. For one thing, how is the decision made on whether or not the student is bored or tired? There may be several references available including glossary, indices, calculator modes, etc. Who decides when each of these is appropriate?

Much more serious weaknesses also are present. The assumption of this type of teaching plan is that the teacher/tutor would operate from the same decision basis each time a student is presented to these topics. In fact, this probably is not the case. This type of plan makes no allowance for future variations in execution based upon the results of present and past decisions. Put in another way, this plan has no provision for the computer to learn from the experiences of different students. This is an important attribute of very good teaching behavior for which we may be a long time perfecting a high fidelity simulation. What is implied is a tutorial program that somehow "learns" from the act and result of each decision made. Such a lesson would include, at each decision point, a menu of alternative choices to be made by the computer, together with a measure of past successes in working each choice. These measures of success might take the form of probabilities reflecting the collected results over previous students of pursuing each alternative. Clearly, a program built this way probably would be less effective in teaching at first than after it had recorded the results of interacting with a number and variety of students. Some successes have been realized in building computer programs to play games such that the program retains and subsequently considers the results of past choices at each decision point. But a game differs markedly from teaching in that the structure and principles (rules) of the environment are much more clearly defined.

We must leave you with an incomplete view of tutorial computer lessons. If educators knew more about tutorial instruction, we might be better able to perfect tutorial computer lessons. For now, the best efforts at this style will be few and will be created by a small but growing set of instructional designers who personally have assimilated the intricacies of this style teaching. It is the case that attempts at the tutorial style get better under thoughtful revisions and trials. Moreover, one should not be discouraged when improvements to a tutorial lesson serve to reveal still more subtle needs for new features.

STUDY ACTIVITIES

1) Find a computer lesson described as TUTORIAL.

A. Study the lesson until you can create a flow chart of its stucture.

B. Analyse the flow chart for decisions not included or for individual student behaviors not accommodated.